Corticosteroid injections for lateral epicondylitis: a systematic review

Smidt, N.; Assendelft, W.J.J.; van der Windt, D.A.W.M.; Hay, E.M.; Buchbinder, R.; Bouter, L.M.

published in
Pain
2002

DOI (link to publisher)
10.1016/S0304-3959(01)00388-8

document version
Publisher's PDF, also known as Version of record

Pain 96 (2002) 23–40

PAIN

www.elsevier.com/locate/pain

Corticosteroid injections for lateral epicondylitis: a systematic review

Nynke Smidt[a,*], Willem J.J. Assendelft[b], Daniëlle A.W.M. van der Windt[b], Elaine M. Hay[c], Rachelle Buchbinder[d], Lex M. Bouter[a]

[a]*Institute for Research in Extramural Medicine, Vrije Universiteit, Faculty of Medicine, Van der Boechorststraat 7, 1081 BT Amsterdam, The Netherlands*
[b]*Department of General Practice, Division of Public Health and Dutch Cochrane Centre, Academic Medical Center, University of Amsterdam, P.O. 22660, 1100 DD Amsterdam, The Netherlands*
[c]*Staffordshire Rheumatology Centre, The Haywood, High Lane, Burslem, Stoke-on-Trent, Staffordshire ST6 7AG, UK*
[d]*Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, Australia*

Received 20 November 2000; received in revised form 10 July 2001; accepted 24 July 2001

Abstract

Patients with lateral epicondylitis (tennis elbow) are frequently treated with corticosteroid injections, in order to relieve pain and diminish disability. The objective of this review was to evaluate the effectiveness of corticosteroid injections for lateral epicondylitis. Randomised controlled trials (RCTs) were identified by a highly sensitive search strategy in six databases in combination with reference tracking. Two independent reviewers selected and assessed the methodological quality of RCTs that included patients with lateral epicondylitis treated with corticosteroid injection(s), and reported at least one clinically relevant outcome measure. Standardised mean differences were computed for continuous data and relative risks (RR) for dichotomous data. A best-evidence synthesis was conducted, weighting the studies with respect to their internal validity, statistical significance, clinical relevance, and statistical power. Thirteen studies consisting of 15 comparisons were included in the review, evaluating the effects of corticosteroid injections compared to placebo injection ($n = 2$), injection with local anaesthetic ($n = 5$), another conservative treatment ($n = 5$), or another corticosteroid injection ($n = 3$). Almost all studies had poor internal validity scores. For short-term outcomes (≤6 weeks), statistically significant and clinically relevant differences were found on pain, global improvement and grip strength for corticosteroid injection compared to placebo, local anaesthetic and conservative treatments. For intermediate (6 weeks–6 months) and long-term outcomes (≥6 months), no statistically significant or clinically relevant results in favour of corticosteroid injections were found. Although the available evidence shows superior short-term effects of corticosteroid injections for lateral epicondylitis, it is not possible to draw firm conclusions on the effectiveness of injections, due to the lack of high quality studies. No beneficial effects were found for intermediate or long-term follow-up. More, better designed, conducted and reported RCTs with intermediate and long-term follow-up are needed.

Keywords: Systematic review; Steroids injections; Lateral epicondylitis; Tennis elbow; Randomised controlled trials

1. Introduction

Lateral epicondylitis (tennis elbow) is a common medical problem. It is considered to be an overload injury typically following minor and often unrecognised trauma (micro-trauma), involving the extensor muscles of the forearm (Murtagh, 1988).

The annual incidence of this disorder is between 1 and 3% in the general population (Allander, 1974; Chard and Hazleman, 1989; Chop, 1989). In general practice the incidence of lateral epicondylitis is estimated at 4–7 per 1000 patients per year (Verhaar, 1992; Hamilton, 1986). The average duration of a typical episode of lateral epicondylitis is supposed to be between 6 months and 2 years (Murtagh, 1988; Hudak et al., 1996).

In Dutch primary care between 14 and 38% of all patients with lateral epicondylitis are treated with corticosteroid injections (Verhaar, 1992; Miedema, 1994). It has been postulated that the effect of corticosteroids is exerted by suppressing or dispersing the granulomatous response in traumatised tissue (Yates, 1977) These anti-inflammatory effects of corticosteroid injections are believed to relieve pain and diminish disability (Gray and Gottlieb, 1983; Goldie, 1972).

In a systematic review, Labelle et al. (1992) evaluated the effectiveness of various treatments for lateral epicondylitis. The review included five (randomised) clinical trials on corticosteroid injections published between 1966 and 1990

* Corresponding author. Tel.: +31-20-4449657; fax: +31-20-4448181.
E-mail address: n.smidt.emgo@med.vu.nl (N. Smidt).

0304-3959/02/$20.00
PII: S0304-3959(01)00388-8

in French or English. Because of the poor quality of methods and the contradictory results Labelle et al. (1992) concluded that there was insufficient scientific evidence for any particular type of treatment for lateral epicondylitis.

Assendelft et al. (1996) performed a more comprehensive systematic review. They reviewed 11 articles and concluded that the existing evidence on the effectiveness of corticosteroid injection for lateral epicondylitis was not conclusive. The methodological quality of the studies was moderate and most studies were conducted in secondary care. However, Assendelft et al. (1996) concluded that corticosteroid injections appear to be relatively safe and seem to have a beneficial short-term effect (2–6 weeks). Since then additional large RCTs have been published and review methodology has been further developed. Therefore, an updated systematic review is required (Meade and Richardson, 1997; Hunt and McKibbon, 1997). The objective of our review is to determine the short (≤6 weeks), intermediate (6 weeks–6 months) and long-term (≥6 months) effectiveness of corticosteroid injection(s) in patients with lateral epicondylitis, based on clinically relevant outcome measures.

2. Methods

2.1. Searching

One reviewer (N.S.) searched computerised bibliographical databases (MEDLINE 01/1966–07/1999, EMBASE 01/1988–07/1999, CINAHL 01/1982–07/1999) without language restrictions (Moher et al., 1996; Gregoire et al., 1995), using the highly sensitive Cochrane Collaboration search strategy, which aims to identify all randomised controlled trials (Mulrow and Oxman, 1997; Van Tulder et al., 1997). Additional specific subject headings and free text words were used to identify papers on lateral epicondylitis and corticosteroid injections. The Cochrane Controlled Trial Register (1999, Issue 2) and Current Contents database (July 1999) was searched using similar terminology. An additional search for systematic reviews was carried out in EMBASE and MEDLINE (Hunt and McKibbon, 1997). Furthermore, a computer-aided search was carried out in the trial register of the Cochrane field of 'Rehabilitation and Related Therapies'. Finally, references from retrieved articles were screened (citation tracking).

2.2. Selection

For this systematic review we included studies that met the following conditions:

1. Treatment regimens were allocated by a random procedure (Schulz et al., 1994). The word "random" or "randomised" should be mentioned;
2. Patients had a clinical diagnosis of lateral epicondylitis, or lateral elbow pain increased by pressure on the lateral epicondyle, and during resisted dorsiflexion of the wrist;
3. At least one of the treatments included one or more corticosteroid injections. Corticosteroid injection(s) had to be contrasted with either no treatment, placebo, local anaesthetic, other corticosteroid injection or other conservative treatments;
4. At least one clinically relevant outcome measure (pain, global improvement, elbow specific functional status, grip strength, or sick leave) was included;
5. Published as a full report before July 1999.

To determine whether a study should be included, the abstracts of all identified hits were assessed by two reviewers (D.A.W.M.W. and N.S.) independently. If there was any doubt, the full article was retrieved, and then blinded for author, journal and year of the trial by a research assistant not involved in any other component of the systematic review (S.K., see acknowledgement), and read by both reviewers independently. Disagreements were discussed and resolved in a consensus meeting.

2.3. Quality assessment

The Amsterdam-Maastricht consensus list (Van der Windt et al., 1999; Van Tulder et al., 1997, 1999) was used for methodological quality assessment, consisting of internal validity criteria, descriptive criteria and statistical criteria (Table 1). To determine the internal validity of the study, for each validity criterion the presence of sufficient information and the likelihood of potential bias was evaluated. Each criterion was rated positive, negative or inconclusive (insufficient information presented). Equal weights were applied, resulting in a total score for internal validity of each study, by summing up the number of positive criteria (range 0–12), higher scores indicating a lower likelihood of bias. In addition, we scored the list of Jadad (Jadad et al., 1996) (See Table 1).

All articles eligible for the review were blinded for authors, journal and year of publication (Jadad et al., 1996). Included articles were independently assessed for methodological quality by two blinded reviewers (N.S. and W.J.J.A.). Overall disagreement was evaluated and expressed as percentage of agreement and kappa statistics (Cohen, 1960; Brennan and Silman, 1992). In a consensus meeting disagreements were discussed and resolved. If consensus could not be reached, a third reviewer (D.A.W.M.W.) made the final decision. The two blinded reviewers (N.S. and W.J.J.A.) independently extracted the data regarding the interventions, timing of outcome assessment, adverse effects, loss to follow-up and results. For studies published in languages other than English, German or Dutch, the help of a native speaker or translator with content expertise was obtained (see acknowledgements).

2.4. Quantitative data synthesis

The results of each RCT were expressed as relative risks (RR) with corresponding 95% confidence interval (95% CI) for dichotomous data, a relative risk smaller than 1.0 indi-

Table 1
Criteria for the methodological assessment of randomised clinical trials[a]

Validity criteria	
V1	Adequate randomisation: adequate procedure for generation of a random number sequence
V2	Concealed randomisation
V3	Baseline similarity of intervention groups
V4	Control for co-interventions in design
V5	Co-interventions reported for each group separately
V6	Adherence to interventions: >70% in intervention groups(s), with exception of waiting list or no treatment group
V7	Care provider blinded
V8	Patient blinded
V9	Withdrawals and drop-outs: ≤20% for short term follow-up, and ≤30% for intermediate term and long term follow-up and no substantial bias (numerical inequality between groups or differences in reasons for withdrawal/drop-out)
V10	Identical timing of outcome assessment
V11	Intention-to-treat analysis
V12	Outcome assessor blinded
Descriptive criteria	
D1	Specification of eligibility criteria
D2	Baseline characteristics described
D3	Description of interventions
D4	Adverse effects described and attributed to allocated treatment, or explicit report of 'no adverse effects'
D5	Short term follow-up (≤6 weeks)
D6	Intermediate term follow-up (6 weeks–6 months)
D7	Long term follow-up (≥6 months)
Statistical criteria	
S1	Presentation of sample size at randomisation and at follow-up
S2	Presentation of point estimates and distribution measures

[a] Operationalisation of the criteria is presented in Appendix A.

cating a beneficial effect of corticosteroid injections (Mulrow and Oxman, 1997). RRs were considered clinically relevant if RR was smaller than 0.7 or larger than 1.5, thus in favour of the index or reference group, respectively. This resembles an absolute difference of 25%. For continuous data the standardised mean difference (SMD) was calculated: $SMD = (0_r - 0_t)/PSD$, where 0_r is mean improvement in the reference group, 0_t is mean improvement in the treatment group, and PSD, pooled standard deviation (Mulrow and Oxman, 1997), SMDs less than zero indicating a beneficial effect in favour of corticosteroid injections. A 95% CI was computed for the SMD. The SMD was interpreted as described by Cohen (1988); i.e., a SMD of 0.2 was considered to indicate a small beneficial effect, 0.5 a medium effect, and 0.8 a large effect of corticosteroid injections. SMDs were considered to indicate a clinically relevant effect if SMD was larger than 0.5.

2.5. Best evidence synthesis

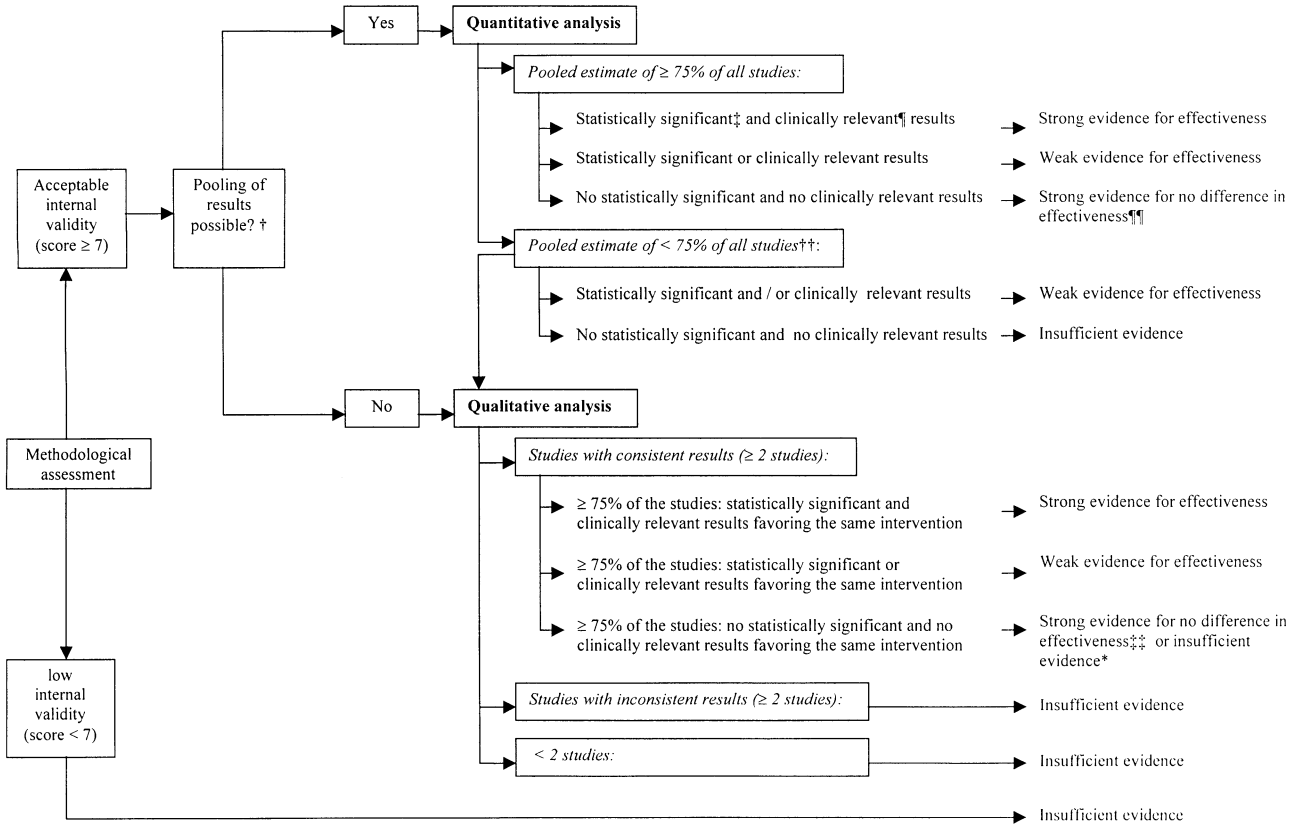
Studies were weighted as to their internal validity, statistical significance, clinical relevance, and power. Decision rules to distinguish between 'strong', 'weak' and 'insufficient' evidence for the effectiveness of corticosteroid injections or for no differences in effect are presented in Fig. 1. Statistically pooling (quantitative analysis) using random effects model, was conducted on the following conditions: Firstly, studies had acceptable internal validity scores (Moher et al., 1998; Schultz et al., 1995) (cut-off point for acceptable internal validity was 7 or more (>50% of total score)); secondly, studies were clinically homogenous, and finally, statistical homogeneity (Chi square test; $P > 0.05$) between studies results existed. Clinically homogeneity between studies existed, if studies were comparable to the timing of outcome assessment: short-term (≤6 weeks), intermediate-term (6 weeks–6 months), and long-term up (≥6 months) follow-up, control group (no treatment, placebo injection, injection with local anaesthetic, other corticosteroid injection, and other conservative treatment), and outcome measure (e.g. pain, global improvement, grip strength).

If a quantitative analysis of data was not possible, conclusions regarding the strength of evidence were based on the consistency of findings between individual studies (qualitative analysis). Results were considered consistent if more than 75% of the studies reported similar results on the same outcome measure (i.e. favouring the same intervention) (Van der Windt et al., 1999; Van Tulder et al., 1999). In case, statistical pooling was only possible for less than 75% of the studies, an additional qualitative analysis was performed. If different conclusions were found between quantitative and qualitative analysis, conclusions were based on the analysis with the strongest evidence (see Fig.1).

3. Results

3.1. Study selection

The results of our search strategy are presented in Fig. 2. Reviewing 248 abstracts and 29 full papers, resulted in



† Pooling of results: Statistical and clinical homogeneity between studies; ‡ Statistically significant: p-value < 0.05; ¶Clinically relevant: for dichotomous outcomes: RR ≤ 0.7 in favour of index group or ≥ 1.5 in favour of reference group, and for continuous outcomes: SMD ≤ -0.5 in favour of indexgroup or ≥ 0.5 in favour of reference group; ¶¶ in case of sufficient power to detect an effect size of 0.5; †† additional qualitative analysis will be performed. If different conclusions were found between quantitative and qualitative analysis, conclusions were based on the analysis with the strongest evidence; ‡‡ in case of sufficient power to detect an effect size of 0.5 in all studies; * in case of insufficient power to detect an effect size of 0.5 in all studies.

Fig. 1. Best-evidence synthesis.

inclusion of 12 articles (Bär et al., 1997; Day et al., 1978; Erturk et al., 1997; Freeland and Gribble, 1954; Haker and Lundeberg, 1993; Halle, 1986; Hay et al., 1999; Murley and Lond, 1954; Oksenberg et al., 1998; Price et al., 1991; Saartok and Eriksson, 1986; Verhaar et al., 1996). Screening the references of all retrieved RCTs and reviews resulted in one additionally eligible RCT (Baily and Brock, 1957).

3.2. Study characteristics

Details regarding the selection criteria, interventions and outcome measures of all included studies are presented in Appendix B.

In almost half of the studies, the duration of the elbow complaints at randomisation was not specified (Baily and Brock, 1957; Freeland and Gribble, 1954; Halle, 1986; Murley and Lond, 1954; Oksenberg et al., 1998; Saartok and Eriksson, 1986). All other studies included a mixed population of patients with acute, subacute and chronic lateral epicondylitis (Bär et al., 1997; Day et al., 1978; Erturk et al., 1997; Haker and Lundeberg, 1993; Hay et al., 1999; Price et al., 1991; Verhaar et al., 1996).

One study (Haker and Lundeberg, 1993) explicitly excluded patients with concomitant neck and/or shoulder complaints, and ten studies (Bär et al., 1997; Day et al., 1978; Erturk et al., 1997; Freeland and Gribble, 1954; Halle, 1986; Hay et al., 1999; Murley and Lond, 1954; Oksenberg et al., 1998; Price et al., 1991; Saartok and Eriksson, 1986) did not specify whether patients had concomitant neck or shoulder complaints.

3.3. Quality assessment

The inter-rater agreement on the internal validity items was good (overall agreement 83% (120/144), kappa statistic 0.62). In a consensus meeting, all disagreements were discussed and resolved. Most disagreements were caused by differences in interpretation of adherence to the intervention (V6) and withdrawals and drop-outs (V9).

In general, the scores for internal validity were low (mean (SD) 3.9 (2.0)). Only one study had an acceptable internal validity score (≥7 points) (Hay et al., 1999). The most prevalent flaws were associated with inadequate control and reporting of co-interventions (V4,V5) and blinding of care provider (V7). Most studies lacked sufficient information on the randomisation procedure (V1, V2), baseline similarity (V3), number of withdrawal and drop-outs (V9)

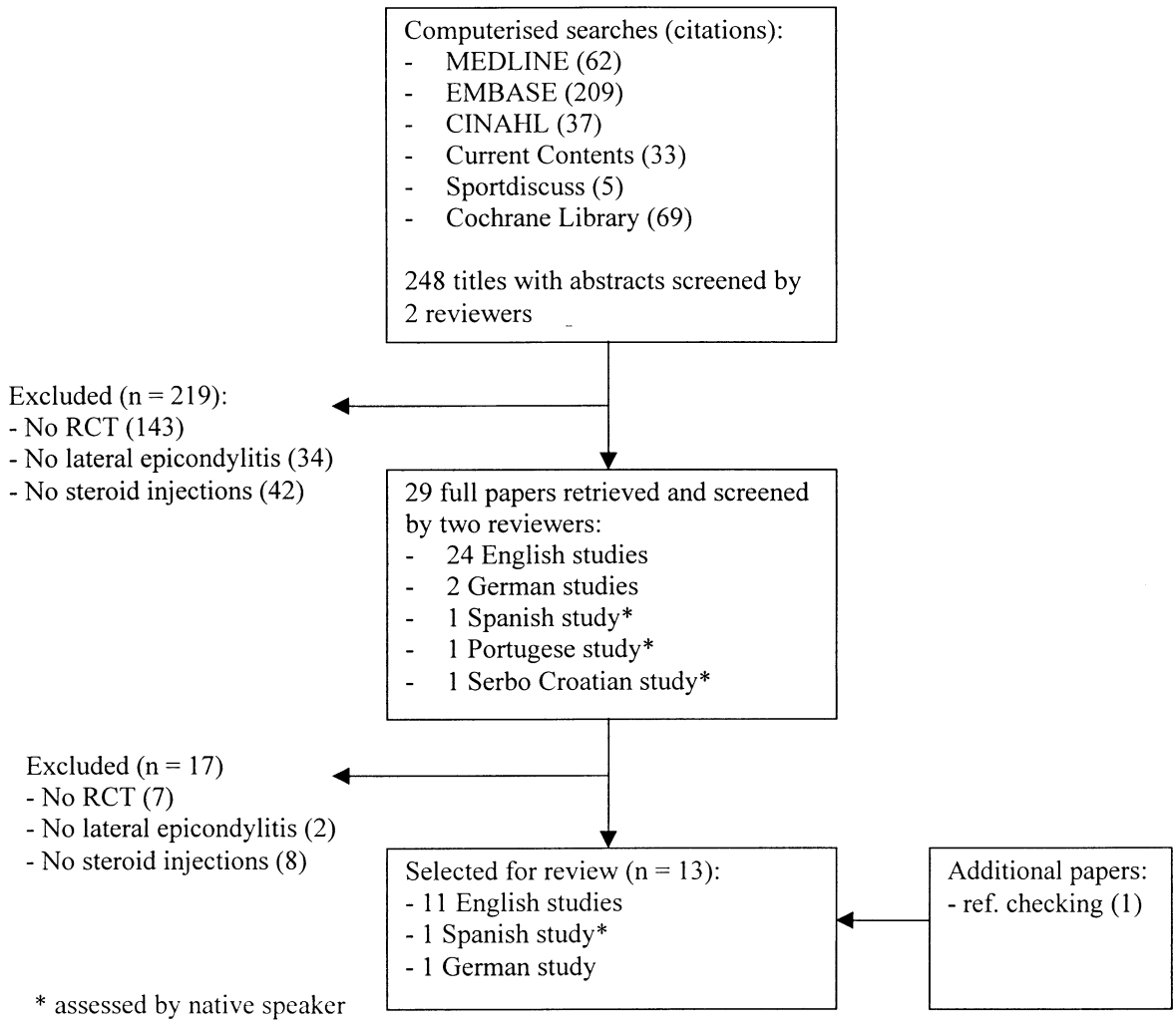


Fig. 2. Selection of studies.

and analysis (V11), making it impossible to determine the likelihood of bias.

3.4. Effectiveness of corticosteroid injections

According to our best-evidence synthesis, there is insufficient evidence to either support or refute the effectiveness of corticosteroid injections compared with placebo, local anaesthetic or other conservative treatments, due to low internal validity scores of nearly all studies. Only one study had an acceptable internal validity score (Hay et al., 1999). As we prefer not to ignore the results of the other available studies, we have carried out a sensitivity analysis, including all available studies.

3.5. Short-term results

Table 2 shows the short-term effects (≤6 weeks) of corticosteroid injections on pain, global improvement and grip strength. Except of one study (Saartok and Eriksson, 1986), all studies who measured and sufficiently reported either pain or global improvement found statistically significant and clinically relevant short-term results in favour of corticosteroid injections.

3.6. Corticosteroid injection compared to placebo injection

Only two studies compared the effects of corticosteroid injection to those of a saline injection (Day et al., 1978; Saartok and Eriksson, 1986). One study (Day et al., 1978) found statistically significant and clinically relevant results in favour of corticosteroid injections. A quantitative analysis for global improvement was not possible, because of statistical heterogeneity. For global improvement, the treatment results of the individual studies were inconsistent. Pain and grip strength was measured by only one study (Saartok and Eriksson, 1986). Therefore, according to the best evidence synthesis, there is insufficient evidence to support or refute the effectiveness of corticosteroid injection compared to placebo injection.

Table 2
Short-term results: summary of validity scores, sample size and effect sizes[a] (95% confidence interval) for pain, global measure of improvement and grip strength

Intervention[b] (index group vs reference group)	Validity score[c]	Oxford score[d]	Sample size[e]	Short term outcome assessment (≤6 weeks)						
				Pain			Global improvement		Grip strength	
				Weeks	SMD	(95% CI)	RR	(95% CI)	SMD	(95% CI)
Placebo treatment										
Corticosteroid injection vs placebo										
Day (1 ml MP-acetate vs 1 ml saline 0.9%)	2	1	29	Unclear	NM		0.11	(0.04, 0.33)	NM	
Saartok (1 ml BM + 0.5 ml Prilocaine + placebo tablets vs Naproxen 250 mg + 1.5 ml saline injection)	2	1	10	2	0.04	(−0.82, 0.90)	1.21	(0.65, 2.26)	0.19	(−0.67, 1.05)
Local anaesthetic										
Corticosteroid injection + local anaesthetic vs local anaesthetic										
Price[l] (2 ml HC 25 mg + lignocaine 1% vs 2 ml lignocaine 1%)	6	3	29	4	−0.62	(−1.15, −0.10)	NM		−0.37	(−0.89, 0.15)
Price[l] (2 ml TC 10 mg + lignocaine 1% vs 2 ml lignocaine 1%)	6	3	29	4	−1.04	(−1.59, −0.50)	NM		−0.43	(−0.95, 0.09)
Corticosteroid injection vs local anaesthetic										
Murley (1 ml HC-acetate 25 mg vs 1 ml procaine 2%)	4	1	18	4	NM		0.32	(0.10, 0.98)	NM	
Day (1 ml MP-acetate vs 1 ml xylocaine 1%)	2	1	35	Unclear	NM		0.10	(0.03, 0.31)	NM	
Conservative treatments										
Corticosteroid injection vs elbow support										
Haker (0.2 ml TC-acetonide 10 mg/ml + 0.3 ml BHC vs elbowband)	3	1	18	2	NM		0.36	(0.18, 0.71)	NA	
Haker (0.2 ml TC-acetonide 10 mg/ml + 0.3 ml BHC vs splintage)	3	1	18	2	NM		0.33	(0.17, 0.65)	NA	
Erturk (20 mg TC + 0.5 ml lidocaine 2% vs epicondylitis bandage)	1	1	8	3	NA		NM		NA	
Corticosteroid injection vs elbow support + NSAID										
Erturk (20 mg TC-acetate + 0.5 ml lidocaine 2% vs acemetacin 90 mg daily + epicondylitis bandage)	1	1	9	3	NA		NM		NA	
Corticosteroid injection + elbow support vs elbow support										
Erturk (20 mg TC-acetate + 0.5 ml lidocaine 2% + epicondylitis bandage vs epicondylitis bandage)	1	1	8	3	NA		NM		−1.01	(−1.99, −0.02)
Corticosteroid injection vs NSAID										
Hay (MP 20 mg + 0.5 ml lignocaine 1% vs Naproxen 500 mg 2 daily 2 weeks)	8	3	53	4	0.57**	(0.43, 0.76)	0.62	(0.49, 0.79)	0.67**	(0.54, 0.84)
Corticosteroid injection vs physiotherapy										
Verhaar (1 ml TC-acetate 1% + 1 ml Lidocaine 1% vs friction massage + Mills' manipulation)	5	3	53	6	0.61**	(0.48, 0.78)	0.45	(0.29, 0.69)	−0.65	(−1.04, −0.25)
Halle (HC + lidocaine vs transcutaneous electrical nerve stimulation)	3	1	12	1	NA		NA		NM	

[a] Values are the effect sizes (95% confidence intervals) for each outcome measure; standardised mean differences (SMD) for continuous outcome measures and relative risks (RR) for dichotomous outcome measures. SMD <0 in favour of corticosteroid injections (index group); RR <1 in favour of corticosteroid injections (index group); NM, not measured; NA, not able to calculate effect sizes due to insufficient data presentation.

[b] MP, methylprednisolone; BM, betamethasone; HC, hydrocortisone; TC, triamcinolone; BHC, bupivacaine hydrochloride.

[c] Validity score: range 0–12; 12 least risk of bias.

[d] Oxford score according list of Jadad (range 0–5).

[e] Smallest group.

**Analysed as dichotomous data (RR).

3.7. Corticosteroid injection compared to injection with local anaesthetic

Three studies compared the effects of corticosteroid injection to a local anaesthetic (Price et al., 1991; Murley and Lond, 1954; Day et al., 1978). All three studies found statistically significant and clinically relevant results in favour of corticosteroid injections on one or more outcome measures. Quantitative analysis showed that the pooled estimate for global improvement was statistically significant and clinically relevant (RR (95%CI): 0.18 (0.08, 0.39). Based on the adjusted best evidence synthesis (sensitivity analysis) there is strong evidence for the effectiveness of corticosteroid injections on global improvement compared to an injection with local anaesthetic. As only one study measured pain and grip strength, there is insufficient evidence for these outcome measures.

3.8. Corticosteroid injection compared to conservative treatment

Five studies compared corticosteroid injections with another conservative treatment (elbow support (Haker and Lundeberg, 1993; Erturk et al., 1997), non-steroidal anti-inflammatory drugs (Hay et al., 1999), physiotherapy (Verhaar et al., 1996; Halle, 1986). The quantitative analysis showed that the pooled estimate for pain was statistically significant and clinically relevant (RR (95%CI): 0.60 (0.50, 0.72). Due to the low number of studies (two out of four) that sufficiently reported data on pain, the best evidence synthesis resulted in weak evidence for the effectiveness of corticosteroid injections compared to other conservative treatments.

Global improvement was assessed in four studies (Halle, 1986; Haker and Lundeberg, 1993; Hay et al., 1999; Verhaar et al., 1996). Quantitative analysis for global improvement showed that the pooled estimate was statistically significant and clinically relevant (RR (95%CI): 0.50 (0.36, 0.70) in favour of corticosteroid injections (strong evidence).

Due to insufficiently presented data and differences in grip strength outcomes (continuous versus dichotomous), quantitative analyses was only possible for two studies (50%) (Erturk et al., 1997; Verhaar et al., 1996). The pooled estimate was statistically significant and clinically relevant (SMD (95%CI): −0.70 (−1.07, −0.33) in favour of injections. The additional qualitative analysis for grip strength showed that 75% of the studies showed statistically significant and clinically relevant results (strong evidence).

3.9. Intermediate and long term effectiveness

Only six studies performed an intermediate (6 weeks–6 months) or long-term (≥6 months) outcome assessment (Freeland and Gribble, 1954; Price et al., 1991; Baily and Brock, 1957; Haker and Lundeberg, 1993; Hay et al., 1999; Verhaar et al., 1996). The results are presented in Table 3. None of the studies found statistically significant results in favour of corticosteroid injections. In contrast, the only study reporting significant differences (Hay et al., 1999) found statistically significant and clinically relevant results for some outcome measures in favour of non-steroidal anti-inflammatory drugs at 6 months of follow-up.

3.10. Effectiveness of different amount, doses and suspensions of corticosteroid injections

Four studies (Bär et al., 1997; Oksenberg et al., 1998; Price et al., 1991 (Price 1 and Price 2) compared different amount, dosages, and suspensions of corticosteroids. Only one study (Oksenberg et al., 1998) found for pain a clinically relevant difference in favour of betamethasone-fosfaat compared to betamethasone-acetate, although this was not statistically significant (SMD: −0.86 (−2.00, 0.28). Statistical pooling of treatment effects was not sensible because nearly each study evaluated a different suspension of corticosteroid. Thus, there is insufficient evidence for the use of any specific amount, dosage or type of corticosteroid suspension.

3.11. Adverse effects

Eight studies provided information on the adverse effects of corticosteroid injections, such as facial flushes, post injection pain and local skin atrophy (Bär et al., 1997; Baily and Brock, 1957; Haker and Lundeberg, 1993; Hay et al., 1999; Saartok and Eriksson, 1986; Price et al., 1991; Murley and Lond, 1954; Verhaar et al., 1996). Post injection pain (11–58%) and local skin atrophy (17–40%) was reported in four studies, but irrespectively whether patients had received a corticosteroid injection, or control treatment (Price et al., 1991; Haker and Lundeberg, 1993; Hay et al., 1999; Saartok and Eriksson, 1986). Occurrence of facial flushes as side-effect of corticosteroid injections was mentioned by only one study (Bär et al., 1997).

4. Discussion

Based on our best evidence synthesis, weighing 13 studies with respect to their internal validity, power, and treatment results, we should conclude that there is insufficient evidence to draw firm conclusions on the overall effectiveness of corticosteroid injections for lateral epicondylitis. This is caused by the low internal validity scores assigned to almost all studies. However, four of the twelve internal validity items were in nearly all studies insufficiently described. Therefore, we decided to perform an sensitivity analysis, including all available studies irrespective of their internal validity scores.

Almost all studies report beneficial short-term effects, which were statistically significant and clinically relevant on nearly all outcome measures in favour of corticosteroid

Table 3
Intermediate and long term results: summary of validity scores, sample size and effect sizes[a] (95% confidence interval) for pain, global measure of improvement and grip strength

Intervention[b] (index group vs reference group)	Validity score[c]	Oxford score[d]	Sample size[e]	Intermediate and long term outcome assessment (> 6 weeks)						
				Pain			Global improvement		Grip strength	
				Weeks	SMD	(95% CI)	RR	(95% CI)	SMD	(95% CI)
Local anaesthetic										
Corticosteroid injection vs local anaesthetic										
Freeland (1 ml HC 25 mg vs 1 ml procaine 5%)	2	2	7	9–17	NM		0.97	(0.41, 2.32)	NM	
Corticosteroid injection + local anaesthetic vs local anaesthetic										
Price[1] (2 ml HC 25 mg + lignocaine 1% vs 2 ml lignocaine 1%)	6	3	29	8	−0.15	(−0.69, 0.38)	NM		−0.16	(−0.69, 0.38)
				24	0.53	(−0.03, 1.09)			−0.16	(−0.71, 0.39)
Price[1] (2 ml TC 10 mg + lignocaine 1% vs 2 ml lignocaine 1%)	6	3	29	8	−0.48,	(−1.02, 0.06)	NM		−0.31	(−0.85, 0.22)
				24	0.39	(−0.16, 0.94)			0.22	(−0.32, 0.77)
Baily (1 ml HC 25 mg + 1-3 ml procaine 2% followed by Mills' manipulation vs 1–3 ml procaine 2% followed by Mills' manipulation)	4	1	20	9	NM		0.67	(0.40, 1.11)	NM	
Conservative treatments										
Corticosteroid injection vs elbow support										
Haker (0.2 ml TC 10 mg/ml + 0.3 ml BHC vs elbowband)	3	1	18	13	NM		0.76	(0.32, 1.80)	NA	
				26			1.83	(0.58, 5.77)		
				52			0.92	(0.27, 3.07)		
Haker (0.2 ml TC 10 mg/ml + 0.3 ml BHC vs splintage)	3	1	18	13	NM		0.52	(0.24, 1.16)	NA	
				26			3.00	(0.73, 12.27)		
				52			1.22	(0.32, 4.65)		
Corticosteroid injection vs NSAIDs										
Hay (MP 20 mg + 0.5 ml lignocaine 1% vs Naproxen 500 mg 2 × daily 2 weeks)	8	3	53	26	1.71**	(1.17, 2.51)	NM		0.98**	(0.78, 1.22)
				52	1.33**	(0.83, 2.15)			1.24**	(0.91, 1.69)
Corticosteroid injection vs physiotherapy										
Verhaar (1 ml TC 1% + 1 ml lidocaine 1% *vs* friction massage + Mills' manipulation)	5	3	53	52	1.20**	(0.96, 1.51)	1.24	(0.81, 1.90)	−0.27	(−0.66, 0.12)

[a] Values are the effect sizes (95% confidence intervals) for each outcome measure; standardised mean differences (SMD) for continuous outcome measures and relative risks (RR) for dichotomous outcome measures. SMD < 0 in favour of corticosteroid injections (index group); RR < 1 in favour of corticosteroid injections (index group); NM, not measured; NA, not able to calculate effect sizes due to insufficient data presentation.

[b] MP, methylprednisolone; HC, hydrocortisone; TC, triamcinolone; BHC, bupivacaine hydrochloride.

[c] Validity score: range 0–12; 12 least risk of bias.

[d] Oxford score according list of Jadad (range 0–5).

[e] Smallest group.

**Analysed as dichotomous data (RR).

injections. These beneficial short-term effects, including diminished pain and increased grip strength, were not found at intermediate or long-term follow-up. By contrast, when comparing corticosteroid injections with another conservative treatment, there is a suggestion of more favourable outcomes at long-term follow-up for medication or physiotherapy (Hay et al., 1999; Verhaar et al., 1996).

4.1. Review methodology

Several aspects of our review methodology are open to discussion. Firstly, although several different databases were used to identify relevant articles, it is possible that we failed to detect relevant publications. We attempted to evaluate the influence of potential publication bias by making a funnel plot (Sutton et al., 2000), plotting the RRs against the sample size of each study. The plot showed a symmetric distribution of studies (data not shown). Furthermore, our comprehensive search had been completed in July 1999. However, an additional search in Medline over the last 2 years did not reveal any additional publications.

Secondly, the conclusions of our review depend on certain decision rules regarding quality assessment and the cut-off points used in our best-evidence synthesis. These decisions are arbitrary, and may of influence on the outcome of a systematic review. Jüni et al. (1999), for example, have shown that the use of different methods for quality appraisal may lead to different conclusions regarding the effectiveness of treatment, based on the same set of trials. We feel that an assessment of methodological quality is an important aspect of systematic reviews, but decided to carry out a sensitivity analysis in which the quality of methods was not considered. The results of this analysis were consistent, irrespective of the validity scores: positive short-term results and negative intermediate- and long-term results. However, we still feel more high-quality studies are necessary.

4.2. Implications for research

Our updated and more extensive review confirms the conclusions by Assendelft et al. (1996), regarding the potentially beneficial outcome of corticosteroid injections within 6 weeks of follow-up. Both reviews stress the poor validity of most studies, although four new recent RCTs were included in our review (Hay et al., 1999; Oksenberg et al., 1998; Bär et al., 1997; Erturk et al., 1997). This again emphasizes the need for good quality RCTs of sufficient size, investigating the short, intermediate, and long-term effects of corticosteroid injections for lateral epicondylitis with standardised outcome measures. The items of our checklist provide good guidance for the design of such studies. More research is also clearly needed to investigate the late possible adverse outcomes of corticosteroid injections at long-term follow-up compared to other conservative treatments (Hay et al., 1999; Verhaar et al., 1996).

In conclusion, corticosteroid injections seem to be effective in the short-term. Additional well-designed trials with long-term follow-up are needed to provide evidence on the beneficial and adverse long-term effects of corticosteroid injections.

Acknowledgements

The authors would like to thank Tatjana Rogic and Maria Paz Atria Lafuente for their help with the selection of RCTs, quality assessment and data-extraction of the Serbo Croatian, Spanish, and Portugese articles, Samyra Keus for blinding the articles, and the Cochrane Musculoskeletal Group Editorial Team for their helpful comments in reviewing the protocol of the review, in special Heather Broughton and Jim Davies for their editorial suggestions to the protocol. Contributors: N.S. co-ordinated the review under supervision of W.J.J.A. and D.A.W.M.W. D.A.W.M.W. selected the literature. W.J.J.A. assessed the studies and retrieved the data. N.S. planned and initiated the review, searched and selected the literature, assessed the studies, retrieved data, analysed and interpreted the results. All authors contributed to the protocol and the composition of the paper. Funding: Dutch Organisation for Scientific Research (NWO) and the Dutch Health Insurance Council. Conflict of interest: None.

Appendix A

Specification of the criteria from Table 1. Each criterion must be applied independently of the other criteria.

In general: ‘NO’ Bias was considered to be likely.

Don’t know: Insufficient information is given, the criterion is rated as inconclusive.

‘YES’: Sufficient information is available and bias is considered to be unlikely

V1. A random (unpredictable) assignment sequence (e.g. numbered, opaque sealed envelopes). Methods of allocation using date of birth, date of admission, hospital numbers, or alternation are not regarded as appropriate (No). If the word ‘random’ or ‘randomised’ is mentioned the answer is ‘Don’t know’.

V2. Assignment generated by an independent person not responsible for determining eligibility of the patients. This person has no information about the persons included in the trial and has no influence on the assignment sequence or the decision about eligibility of the patient.

V3. In order to receive a ‘yes’ groups have to be similar regarding four of the most important prognostic factors: age, duration of complaints, concomitant neck and shoulder complaints and baseline main outcome measure(s). If a baseline difference exists in one of these factors, a ‘no’ applies.

V4. Co-interventions concerning other physical therapy

modalities, oral medication or injections are either standardised or avoided in trial design.

V5. A report on co-interventions for each group separately.

V6. The reviewer determines whether the adherence to the interventions is acceptable, based on the reported intensity, duration, number and frequency of sessions for both the index intervention and control intervention(s). Arbitrarily an adherence >70% in index group(s) and in placebo-controlled trials also in control group(s) is considered to be sufficient.

V7. The reviewer determines if enough information about the blinding is given in order to score a yes'. For exercise therapy this item always scores a 'no'.

V8. The reviewer determines when enough information about the blinding is given in order to score a 'yes'. For exercise therapy and 'hands-on' therapy, like massage or manipulation, this item always scores a 'no'.

V9. Participants who were included in the study but did not complete the observation period or were not included in the analysis must be described. If the percentage of withdrawals and dropouts does not exceed 20% for short-term follow-up and 30% for intermediary-term and long-term follow-up and does not lead to substantial bias a 'yes' is scored. No report of dropouts scores as 'don't know'.

V10. Timing of outcome assessment identical for all intervention groups; for all important outcome assessments.

V11. All randomised patients are reported/analysed for the most important moments of effect measurement (minus missing values) irrespective of non-compliance and co-interventions.

V12. The reviewer determines when enough information about blinding is given to score a 'yes'.

D1. In order to score a 'yes' explicit classification criteria for lateral epicondylitis should be described.

D2. In order to receive a 'yes' groups have to be described regarding four of the most important prognostic factors: age, duration of complaints, neck and shoulder complaints and baseline main outcome measure(s).

D3. Adequate description of type, modality, application technique, intensity, duration, frequency of sessions for both the index intervention and control intervention(s) in order to be able to replicate the study.

D4. Each event described and correctly attributed to allocated treatment; if explicit report of 'no adverse effects', a 'yes' applies. Scores either a 'yes' or a 'no', a 'don't know' doesn't exist.

D5. Outcome assessment ≤6 weeks after randomisation.

D6. Outcome assessment >6 weeks and <6 months after randomisation.

D7. Outcome assessment ≥6 months after randomisation.

S1. To be presented per group at randomisation, for main outcome assessment and for separate short, intermediate and long-term follow-up moments.

S2. For all of the important outcome measures (pain, global improvement, elbow specific functional status) both point estimates and measures of variability should be presented separately. Point estimates are: means, medians, modes, etc.; Measures of variability are: standard deviations, 95% confidence intervals, etc. For dichotomous or categorical data proportions have to be presented or enough data presented to be calculated.

Appendix B.: Characteristics of included studies (alphabetical order)

Study characteristics

Study	Methods	Participants	Interventions	Outcome	Notes
Bär et al. (1997)	Randomisation procedure not described. Patient blinded for intervention; care provider not blinded for intervention. No information on blinding outcome assessor. Outcome assessment at 2, 7 and 21 days after randomisation. Drop-outs: i, six patients (5%); ii, eight patients (7%) at 21 days after randomisation.	246 patients with epicondylitis humeri radialis. Mean age (sd): 48.5 years (12.0), women: 129 (52%). Duration of elbow complaints: 135 (55%) acute, 111 (45%) chronic. Inclusion criteria: pain by pressure on lateral epicondyl, pain at lateral epicondyl for at most 7 days, pain by resisted elbow flexion. Exclusion criteria: not described.	i, Injection with 1.5 ml dexamethason-21-palmitate ($n = 123$). ii, Injection with 1 ml dexametason-21-acetaat ($n = 123$). Co-interventions: not reported Adverse effects: i, Warm sensation at the elbow ($n = 1$), slight haemorrhage ($n = 1$); ii, facial flush ($n = 3$), red coloured elbow ($n = 1$), skin irritation of the shoulder ($n = 1$), inflammation of the bladder ($n = 1$).	Results at 2 days*:* (a) pain by pressure on lateral epicondyl (5 point scale): i, 15/123; ii, 17/123 very painful; (b) pain by resisted elbow flexion (5 point scale): i, 12/123; ii, 13/123, (c) patient satisfaction: i, 72% (89/123); ii, 68% (84/123) much improved/completely recovered; (d) severity of the elbow complaints according to the care provider: i, 71% (87/123); ii, 67% (82/123) much improved/completely recovered. Results at 1 week: (a) pain by pressure on lateral epicondyl (5 point scale): i, 14/123; ii, 12/123 very painful; (b) pain by resisted elbow flexion (5 point scale): i, 10/123; ii, 9/123 (c) patient satisfaction: i, 74% (91/123); ii, 69% (85/123) much improved/ completely recovered; (d) severity of the elbow complaints according to the care provider: i, 74% (91/123); ii, 70% (86/123) much improved/ completely recovered. Results at 3 weeks: (a) pain by pressure on lateral epicondyl (5 point scale): i, 17/117; ii, 12/115 very painful; (b) pain by resisted elbow flexion (5 point scale): i, 11/117; ii, 10/115; (c) patient satisfaction: i, 74% (87/117); ii, 72% (83/115) much improved/ completely recovered, (d) severity of the elbow complaints according to the care provider: i, 76% (89/117); ii, 72% (83/115) much improved/completely recovered.	Conclusions of authors: 'positive' for dexamethason-21-palmitate. In contrast to our conclusions.
Baily and Brock (1957)	Randomisation: divided into two random groups. Outcome assessor blinded for intervention; care provider not blinded for intervention. No information on blinding patient. Outcome assessment at 2 months after randomisation. Drop-outs: nine patients because of non-attendance (group unclear).	40 patients with tennis elbow in secondary care. Mean age: 45.5 years, women: 26 (65%). In- and exclusion criteria: not reported	i, Injection with 1 ml hydrocortisone acetate (25 mg) + 1–3 ml procaine 2% followed by Mill's manipulation ($n = 20$). ii, Injection with 1–3 ml procaine 2% followed by Mill's manipulation ($n = 20$) Co-interventions: unclear (where symptoms were unchanged after 3 weeks a course of physiotherapy was instituted and in eight cases still unrelieved after 2 months a second injection of hydrocortisone was given) Adverse effects: i, exacerbation of symptoms for 48 h ($n = 5$), ii, exacerbation of symptoms for 48 h ($n = 5$).	Results after 9 weeks*:* (a) global measure of improvement (4 point scale): i, 10/20; ii, 5/20 relieved of all symptoms. In addition, the results were analysed in relation to age, history of trauma, length of history, the presence of associated symptoms in the neck and shoulder, and presence or absence of previous treatment. None of these factors showed any significant effect on the pattern of the results.	Conclusions of authors: 'positive' in favour of injection with 1 ml hydrocortisone acetate (25 mg) + 1–3 ml procaine 2%.

(*continued*)

Study characteristics

Study	Methods	Participants	Interventions	Outcome	Notes
Day et al. (1978)	Randomisation procedure not described. Outcome assessor blinded for intervention. Care provider not blinded for intervention. No information on blinding patient. Outcome assessment: fortnightly until the patients were either relieved of symptoms or changed to another therapy owing to failure. Minimum follow-up period of 1 year and a maximum of 4 years. No information on drop-outs.	95 patients (100 tennis elbows) with tennis elbow in secondary care. Range age: 17–72, women: 49 (52%), duration of elbow complaints: 10% (<1 month), 56% (1–3 months), 18% (4–6 months), 10% (7–12 months), 6% (> 12 months). Inclusion criteria: tenderness at the lateral epicondyl and the presence of Mill's sign (pain at the site of tenderness when the elbow is extended with the forearm fully pronated and the wrist fully flexed). Exclusion criteria: not reported.	i, Injection with 1 ml methylprednisolone acetate ($n = 36$). ii, Injection with 1 ml xylocaine 1% ($n = 35$). iii, Injection with 1 ml saline 0.9% ($n = 29$). No information on co-interventions and adverse effects.	Results after one or two injections (timing of outcome assessment is unclear): (a) Global measure of improvement (4-point scale: cured, very much improved, only slow improvement, worse): i, 33/36 elbows; ii, 7/35; iii, 7/29 completely recovered or very much improved.	Conclusions of authors: 'positive' in favour of methyl prednisolone acetate.
Erturk et al. (1997)	Randomly split in four groups. Patient and care provider not blinded for intervention. No information on blinding outcome assessor. Outcome assessment at 3 weeks after randomisation. No information on drop-outs.	36 patients with lateral epicondylitis in secondary care. Mean age (range): 47.6 years (36–66), women: 25 (69%), mean duration of elbow complaints (range): 17.7 weeks (3–156). Inclusion criteria: history of pain on gripping and tenderness over the lateral epicondyle. Exclusion criteria: history of systemic diseases (like diabetes mellitus, chronic renal insufficiency etc.), recurrence in the last year, treatment period for present complaints.	i, Local injection with 20 mg triamcinolone acetate combined with 0.5 ml 2% lidocaine ($n = 9$). ii, Local injection with 20 mg triamcinolone acetate combined with 0.5 ml 2% lidocaine + epicondylitis bandage ($n = 10$). iii, Epicondylitis bandage ($n = 8$). iv, NSAID (acemetacin 90 mg/daily in a single dose) + epicondylitis bandage ($n = 9$). No information on co-interventions and adverse effects.	Baseline results: (a) mean (range) pain at rest (VAS): i, 12.44 (0–52); ii, 10.30 (0–34); iii, 12.88 (0–41); iv; 17.89 (0–45); (b) mean (range) pain during resistive wrist extension (VAS): i, 47.0 (17–76); ii, 43.70 (16–79); iii, 59.63 (42–80); iv. 38.33 (5–75); (c) mean (range) tenderness over the lateral epicondyle (0–3): i, 1.89 (1–3); ii, 2.10 (1–3); iii, 2.38 (2–3); iv, 2.00 (1–3); (d) mean (range) grip strength (kg): i, 18.52 (7.6–30); ii, 17.85 (11.3–26.3); iii, 15.35 (9.6–21.6); iv, 18.20 (7.3–30). Results after 3 weeks: Mean improvement (a) pain at rest (VAS): i, 7.67; ii, 10.30; iii, 5.13; iv, 10.78; (b) pain during resistive wrist extension (VAS): i, 27.11; ii, 40.90; iii, 13.62; iv, 12.56; iii vs iv. $P < 0.05$, ii vs iii $P < 0.05$; (c) tenderness over de lateral epicondyle (0–3): i, 1.22; ii, 1.20; iii, 0.63; iv; 0.89; (d) grip strength (kg): i, 3.66; ii, 5.40; iii, 0.42; iv, 1.69, ii vs iii, $P < 0.05$.	Conclusions of authors: local injection is more effective than either epicondylitis bandage or NSAID alone in tennis elbow, especially when combined with epicondylitis bandage.
Freeland and Gribble (1954)	Randomisation in pre-determined random order. Patient and care provider not blinded for intervention. Outcome assessor blinded for intervention. Outcome assessment at 2–4 days, 1 week, 3 weeks and monthly. No information on drop-outs.	14 patients (16 elbows) with tennis elbow. No information on age, gender and duration of complaints. Inclusion criteria: (1) tenderness over the anterior aspect of the lateral epicondyle, (2) pain in the extensor origin, radiating down the arm on gripping and on resisted extension of the wrist, and (3) full range of passive movements of the elbow. Exclusion criteria: If the tenderness or pain were classified as 'none' or 'slight'.	i, Local injection of 1 ml hydrocortisone 25 mg ($n = 9$). ii, Local injection of 1 ml procaine 5% ($n = 7$). No information on co-interventions and adverse effects.	Results at 9–17 weeks: (a) Global measure of improvement (4 point scale): i, 4/9; ii, 3/7 distinct improvement.	Conclusions of authors: 'no significant difference'.

(*continued*)

Study characteristics

Study	Methods	Participants	Interventions	Outcome	Notes
Haker and Lundeberg (1993)	Randomisation procedure not described. Patient and care provider not blinded for intervention. No information on blinding outcome assessor. Outcome assessment at 2 weeks, 3, 6 and 12 months. Drop-outs: ii, One patient (5%) after 2 weeks, i, one; ii, two; iii, eight patients after 3 months: i, nine; ii; seven; iii; seven patients. After 6 months. i, ten; ii, seven; iii, eight patients after 1 year.	61 patients with lateral epicondylalgia in secondary care. Mean age (range): 47.9 (26.8–75.8), women: 19 (34%), median duration of elbow complaints (range): 5 months (1–36). Inclusion criteria: pain duration of 1 month and a record of pain over the lateral epicondyl during two or more of the four following clinical tests: (1) palpation of the lateral epicondyl, (2) resisted wrist extension, (3) passive stretching of the extensor muscle group, (4) resisted finger extension. Exclusion criteria: dysfunction in the shoulder, neck and/or thoracic region; local arthritis or generalised polyarthritis; neurological abnormality, radial nerve entrapment.	i, Local injection of 0.3 ml bupivacaine hydrochloride and 0.2 ml triamcinolone acetonide 10 mg/ml. If no effect was observed within 1 week a second injection was given ($n = 19$). ii, Elbow-band group ($n = 18$). iii, Splintage group ($n = 19$). Instruction all groups: use the arm but avoid painful movements. Instructions for group ii and iii: use support daily during activity for 3 months. Co-interventions: none. Adverse effects: i, two patients (11%) worsening of pain after injection.	Baseline results: (a) median vigorimeter test (Kpa): i, 24; ii, 39; iii, 20. Results after 2 weeks: (a) Median improvement on vigorimeter: i, 28; ii, 2; iii, 3. (b) Global measure of improvement (5 point-scale): i, 13/19; ii, 2/17; iii, 1/19 excellent or good results. Results after 13 weeks: (a) Median improvement on vigorimeter: i, 33; ii, 10; iii, 20; (b) Global measure of improvement (5 point-scale): i, 12/18; ii, 9/16; iii, 4/11 excellent or good results. Results after 26 weeks: (a) Median improvement on vigorimeter: i, 26; ii, 36; iii, 38. (b) Global measure of improvement (5 point-scale): i, 5/10; ii, 8/11; iii, 10/12 excellent or good results. Results after 52 weeks: (a) Median improvement on vigorimeter: i, 40; ii, 48; iii, 42; (b) Global measure of improvement (5 point-scale): i, 6/9; ii, 7/11; iii, 8/11 excellent or good results.	Conclusions of authors: 'positive' in favour of the injection group for at 2 weeks follow-up, however no significant differences could be reported at long term follow-up.
Halle (1986)	Randomisation: table of random numbers. Care provider, patient outcome assessor not blinded for intervention. Outcome assessment after 5 days. No information on drop-outs.	48 patients with lateral epicondylitis in primary care: Army Medical Department. Range age: 20–59 years; women 26 (54%) for all patients. Inclusion criteria: Localised pain over the common extensor tendon origin with resisted wrist extension and point tenderness over the lateral epicondyle. Exclusion criteria: positive neurological examination.	i, Ultrasound using conventional coupling medium 20 min, daily, five treatments ($n = 12$). ii, Ultrasound with 10% hydrocortisone coupling; 20 min, daily; five treatments ($n = 12$). iii, Transcutaneous electrical nerve stimulation, 20 min; daily, five treatments ($n = 12$). iv, Subcutaneous injection with hydrocortisone and lidocaine ($n = 12$). Standardised home programme: tennis elbow cuff, avoiding strenuous activity, ice massages daily. No information on adverse effects.	Results after 1 week: Insufficient data.	Conclusion of authors: 'no significant difference'.

(*continued*)

Study characteristics

Study	Methods	Participants	Interventions	Outcome	Notes
Hay et al. (1999)	Randomisation: random number table (blocks of six). Patient and care-provider not blinded for intervention. Outcome assessor blinded for intervention. Outcome assessment at 4 weeks, 6 months and 12 months. Drop-outs: iii, one patient after 12 months follow-up.	164 patients with lateral epicondylitis of elbow in primary care. Range age: 18–70 years, women: 78 (48%), duration of elbow complaints: 50 patients (30%) $>$ 3 months. Inclusion criteria: pain and tenderness in the lateral region of the elbow; no consultation with symptoms in the same elbow during the preceding 12 months; age 18–70 years. Exclusion criteria: history of inflammatory arthritis or gross structural abnormality of the elbow; contraindications to non-steroidal anti-inflammatories or local steroid injection; pregnancy or breast feeding.	i, Local corticosteroid injection of methylprednisolone 20 mg + 0.5 ml lignocaine 1% ($n = 53$). ii, Naproxen 500 mg twice daily for 2 weeks ($n = 53$). iii, Placebo tablets twice daily for 2 weeks ($n = 58$). Standard advice was given to take the drug with food and about potential side effects for groups ii and iii, All participants were provided with co-codamol for additional pain relief and an information leaflet about 'tennis elbow'. Co-interventions: i, six (12%); ii, nine (18%); ten (19%) patients received co-interventions at 4 weeks; i, 17 (35%), 19 (38%), 19 (37%) patients received co-interventions during 12 months follow-up. Adverse effects: i, post injection pain (number of patients unknown); ii, four patients gastrointestinal side effects, one patient allergic reaction (oedema) Local skin atrophy at the lateral epicondyle at 6 and 12 months: three patients (ii and iii group).	Baseline results: (a) Elbow pain today: i, 50/53; ii, 51/53; iii, 57/58, (b) Pain every day for 1 week: i, 50/53; ii, 47/53; iii, 50/58, (c) pain free grip strength $>$ 300 mm Hg (average of two readings with hand held dynamometer): i, 3/53; ii, 1/53; iii, 1/58, (d) definite pain on resisted extension of middle finger on 3 point scale (none, some, definite with flinch): i, 18/53; ii, 24/53; iii, 20/58, (e) definite pain on resisted extension of wrist on 3 point scale (none, some, definite with flinch): i, 22/53; ii, 25/53; iii, 28/58, (f) definite tenderness of lateral epicondyle on 3 point scale (none, some, definite with flinch): i, 23/53; ii, 15/53; iii, 24/58, (g) disability: dressing: i, 32/53; ii, 29/53, iii, 31/58; feeding: i, 41/53; ii, 44/53; iii, 42/58; washing: i, 38/53; ii, 41/53; iii, 45/58, household tasks: i, 50/53; ii, 49/53; iii, 55/58; opening doors: i, 24/53; ii, 24/53; iii, 26/58, carrying objects: i, 51/53; ii, 49/53; iii, 57/58; with work: i, 46/53; ii, 47/53; iii, 52/58, with sport: i, 36/53; ii, 35/53; iii, 42/58; (h) median pain severity on 10 point Likert scale (IQR): i, 6 (4, 7); ii, 4 (2.8, 6.3); iii, 5 (4, 7); (l) median impairment of function on 10 point Likert scale (IRQ): i, 4 (2, 5); ii, 4 (2, 5); iii, 4 (2, 5); (m) median severity of 'main complaint' on 10 point Likert scale (IRQ): i, 6 (4, 7); ii, 5 (4, 7); iii, 5.5 (3, 7). Results after 4 weeks: (a) Elbow pain today: i, 27/53; ii, 47/53; iii, 51/58, (b) pain every day for 1 week: i, 22/53; ii, 38/53; iii, 43/58; (c) pain for at least 1 day in past week: i, 30/53; ii, 50/53; iii, 55/58, (d) pain free grip strength $>$ 300 mm Hg (average of two readings with hand held dynamometer): i, 20/53; ii, 4/53; iii, 8/58; (e) pain on extension of middle finger on 3 point scale (none, some, definite with flinch): i, 26/53; ii, 48/53, iii, 45/58; (f) pain on extension of wrist on 3 point scale (none, some, definite with flinch): i, 19/53; ii, 45/53; iii, 47/58; (g) definite tenderness of lateral epicondyle on 3 point scale (none, some, definite with flinch): i, 31/53; ii, 49/53; iii, 53/58, (h) Disability: dressing: i, 11/53; ii, 30/53; iii, 28/58; feeding: i, 20/53; ii, 34/53; iii, 35/58; washing: i, 20/53; ii, 33/53; iii, 39/58; household tasks: i, 23/53; ii, 43/53; iii, 46/58; opening doors: i, 12/53; ii, 23/53; iii, 23/58; carrying objects: i, 24/53; ii, 47/53; iii, 49/58; with work: i, 19/53; ii, 35/53; iii, 38/58; with sport: i, 20/53; ii, 31/53; iii, 33/58; (i) pain improvement VAS (score $\leq$3): i, 41/53; ii, 25/53; iii, 28/58 better, (j) global measure of improvement on 5 point scale (complete recovered, improved, no change, worse, much worse): i, 22/53; ii, 3/53; iii, 2/58 completely recovered, (k) median pain severity on 10 point Likert scale (IQR): i, 1 (0, 3); ii, 4 (2, 6); iii, 3.5 (2, 6); (l) median impairment of function on 10 point Likert scale (IQR): i, 0 (0, 2); ii, 3 (1, 5); iii, 2 (1, 4); (m) median severity of 'main complaint' on 10 point Likert scale (IRQ): i, 1 (0, 2); ii, 4 (1, 6); iii, 3 (1, 5). Results after 26 weeks: (a) Elbow pain today: i, 36/53; ii, 21/53; iii, 26/58; (b) pain every day for 1 week: i, 28/53; ii, 16/53; iii, 19/58; (c) pain for at least 1 day in past week: i, 46/53; ii, 29/53; iii, 37/58; (d) pain free grip strength $>$ 300 mm Hg (average of two readings with hand held dynamometer): i, 14/53; ii, 13/53; iii, 18/58; (e) pain on extension of middle finger on 3 point scale (none, some, definite with flinch): i, 38/53; ii, 27/53, iii; 32/58, (f) pain on extension of wrist on 3 point scale (none, some, definite with flinch): i, 39/53; ii, 25/53; iii, 32/58; (g) definite tenderness of lateral epicondyle on 3 point scale (none, some, definite with flinch): i, 42/53; ii, 32/53; iii, 36/58; (h) Disability: dressing: i, 16/53; ii, 5/53; iii, 10/58; feeding: i, 28/53, ii, 18/53, iii, 19/58; washing: i, 24/53; ii, 15/53;	Conclusions of authors: positive in favour of the injection group. No statistically significant difference was found for naproxen compared to placebo naproxen.

(*continued*)

Study characteristics

Study	Methods	Participants	Interventions	Outcome	Notes
				iii, 22/58; household tasks: i, 35/53; ii, 25/53; iii, 26/58; opening doors: i, 15/53; ii, 4/53; iii, 7/58; carrying objects: i, 38/53; ii, 22/53; iii, 34/58; with work: i, 28/53; ii, 19/53; iii, 24/58, with sport: i, 23/53; ii, 18/53; iii, 19/58; (i) VAS pain scores (≤3 = better): i, 33/53; ii, 42/53; iii, 47/58 better; (j) median (IQR) pain severity on 10 point Likert scale: i, 2 (1, 5); ii, 1 (0, 3); iii, 1 (0, 2.3); (k) median (IQR) impairment of function on 10 point Likert scale: i, 1 (0, 3); ii, 0 (0, 2.8); iii, 0.5 (0, 2.8); (d) median (IQR) severity of 'main complaint' on 10 point Likert scale: i, 2 (0, 4), ii, 0 (0, 3), iii, 1 (0, 4). Results after 52 weeks: (a) Elbow pain today: i, 24/53; ii, 18/53; iii, 20/57, (b) pain every day for 1 week: i, 17/53; ii, 12/53; iii, 12/57; (c) pain for at least 1 day in past week: i, 37/53; ii, 25/53; iii; 27/57; (d) pain free grip strength >300 mm Hg (average of two readings with hand held dynamometer): i, 17/53; ii, 24/53; iii, 23/57, (e) pain on extension of middle finger on 3 point scale (none, some, definite with flinch): i, 25/53; ii, 24/53; iii, 21/57; (f) pain on extension of wrist on 3 point scale (none, some, definite with flinch): i, 29/53; ii, 20/53; iii, 20/57, (g) tenderness of lateral epicondyle on 3 point scale (none, some, definite with flinch): i, 35/53; ii, 25/53; iii, 34/57; (h) Disability: dressing: i, 13/53; ii, 4/53; iii, 9/57; feeding: i, 17/53; ii, 12/53, iii, 13/57; washing: i, 19/53; ii, 12/53; iii, 13/57; household tasks: i, 29/53; ii, 19/53; iii, 24/57; opening doors: i, 9/53; ii, 1/53; iii, 9/57; carrying objects: i, 32/53; ii, 24/53; iii, 30/57; with work: i, 23/53; ii, 14/53; iii, 18/57; with sport: i, 18/53; ii, 14/53; iii, 15/57; (i) VAS pain scores (≤3 = better): i, 43/53; ii, 45/53; iii, 44/57 better; (j) median (IQR) pain severity on 10 point Likert scale: i, 1 (0, 2); ii, 0 (0, 2); iii, 0 (0, 2); (c) median (IQR) impairment of function on 10 point Likert scale: i, 0 (0, 2); ii, 0 (0, 1); iii, 0 (0, 0); (d) median (IQR) severity of 'main complaint' on 10 point Likert scale: i, 1 (0, 3.8); ii, 0 (0, 1.3); iii, 1 (0, 3.8). Other outcome measures: number and type of co-interventions, time off paid employment, complications of treatment.	
Murley and Lond (1954)	Randomisation procedure not described. Patient and care provider not blinded for intervention. Outcome assessor blinded for intervention. Outcome assessment at 1 and 4 weeks. No information on drop-outs.	37 patients with tennis elbow in secondary care. Mean age: i, 41; ii, 43 years; women: i, 4 (21%); ii, 3 (17%). No information on in- and exclusion criteria.	i, 1 ml. (25 mg) hydrocortisone acetate injection ($n = 19$) ii, 1 ml. procaine 2% ($n = 18$). No information on co-interventions. Adverse effects: ii, increase of pain for 24 h (number of patients is unclear).	Results after 1 week: (a) global measure of improvement on 3 point scale (improved, unchanged, worse): i, 14/19, ii, 7/18 improved. Results after 4 weeks: (a) global measure of improvement on 3 point scale (improved, unchanged, worse): i, 16/19; ii, 9/18 improved.	Conclusions of authors: positive in favour of hydrocortisone acetate injection.
Oksenberg et al. (1998)	Randomisation: table of random numbers. Patient, outcome assessor and care provider blinded. Outcome assessment at 30 days. No information on drop-outs.	14 patients with epicondylitis in secondary care. Mean (sd) age: i, 52 (9.5) years; ii, 45.6 (5.1) years; women: i, 6 (67%); ii, 5 (100%). Inclusion criteria: elbow pain for more than 5 days, pressure pain, pain when squeezing by patient, no evidence of intra-articular involvement. Exclusion criteria: osteochondritis dissecans, endocrinal disorders, injection in preceding 6 months, rheumatoid arthritis, Diabetes Mellitus.	i, 3 ml betamethason phosphate (3 mg) + 2 ml lidocaine 2% injection ($n = 9$). ii, 3 ml betamethasone acetate (3 mg) + 2 ml lidocaine 2% ($n = 5$). No information on co-interventions and adverse effects.	Baseline: (a) mean (sd) pain (VAS): i, 7.0 (2.1); ii, 4.6 (2.8); (b) mean (sd) pressure pain (3 point scale): i, 2.4 (0.5); ii, 2.6 (0.5). Results after 5 weeks: (a) mean (sd) pain (VAS): i, 1.4 (2.5); ii, 1.2 (1.6); (b) mean (sd) pressure pain (0–3): i, 0.4 (0.7); ii, 0.6 (0.5).	

(*continued*)

Study characteristics

Study	Methods	Participants	Interventions	Outcome	Notes
Price[1] et al. (1991)	Randomisation procedure not described. Patient and outcome assessor blinded. No information on blinding care provider. Outcome assessment at 4, 8 and 24 weeks. Drop-outs: ii, one patient after 4 weeks, i, two; ii, three, iii, two patients after 8 weeks, i, three, ii, three, iii, four patients after 24 weeks.	89 patients with lateral epicondylitis in secondary care. Median age (range): i, 47 years (34–64); ii, 47 years (19–62); iii, 46 years (32—62); women: i, 14 (48%); ii, 13 (43%); iii, 11 (38%); median duration elbow complaints (range): i, 20 weeks (6–150); ii, 36 weeks (6–154); iii, 16 weeks (4–152). Inclusion criteria: history of pain on gripping or extensor stress test together with tenderness over the lateral epicondyle or adjacent tissues. Exclusion criteria: recent failed treatment, including corticosteroid injections.	i, 2 ml hydrocortisone (25 mg) + lignocaine 1% ($n = 29$); ii, 2 ml triamcinolone (10 mg) + lignocaine 1% ($n = 30$) iii, 2 ml lignocaine 1% ($n = 29$) Injection repeated after 4 weeks if necessary. No information on co-interventions. Adverse effects: i, 17 (58%); ii, 13 (43%); iii, nine (11%) patients had post-injection pain; i, six (21%); ii, 12 (40%); iii, five (17%) patients in whom skin atrophy was observed.	Baseline: (a) mean (95% CI) pain VAS: i, 49 (41, 58); ii, 47 (39, 55); iii, 50 (42, 58); (b) mean (95% CI) tenderness score (0–3): i, 2.2 (2.0, 2.5); ii, 2.1 (1.8, 2.4); iii, 2.0 (1.7, 2.3); (c) mean (95% CI) pain weighted grip strength: i, 135 (106, 164); ii, 158 (128, 188); iii, 151 (119, 184). Results after 4 weeks: (a) mean (95% CI) pain VAS: i, 28 (18, 38); ii, 17 (10, 25); iii, 46 (37, 55); (b) mean (95% CI) tenderness score (0–3): i, 1.1 (0.7, 1.5); ii, 0.6 (0.3, 0.9); iii, 1.8 (1.4, 2.1); (c) mean (95% CI) pain weighted grip strength: i, 203 (169, 236); ii, 231 (202, 261); iii, 184 (153, 214). Results after 8 weeks: (a) mean VAS (95% CI) pain: i, 30 (19, 41); ii, 20 (10, 30); iii, 35 (26, 43); (b) mean (95% CI) tenderness score (0–3): i, 0.9 (0.5, 1.4); ii, 0.6 (0.3, 0.9); iii, 1.4 (1.0, 1.8); (c) mean (95% CI) pain weighted grip strength: i, 200 (162, 237), ii, 238 (205, 272), iii, 201 (168, 234). Results after 24 weeks: (a) mean (95% CI) pain VAS: i, 24 (14, 35); ii, 18 (7, 28); iii, 12 (8, 17); (b) mean (95% CI) tenderness score (0–3): i, 0.9 (0.5, 1.3); ii, 0.6 (0.2, 1.0); iii, 0.7 (0.3, 1.1); (c) mean (95% CI) pain weighted grip strength: i, 237 (209, 265); ii, 238 (207, 269); iii, 251 (220, 282).	Conclusions of authors: more rapid relief of symptoms for 10 mg triamcinolone than 25 mg hydrocortisone or lignocaine alone.
Price[2] et al. (1991)	Randomisation procedure not described. Patient and outcome assessor blinded. No information on blinding care provider. Outcome assessment at 4, 8 and 24 weeks. Drop-outs: i, two; ii, four patients after 4 weeks; i, six, ii, five patients after 8 weeks; i, three; ii, five patients after 24 weeks.	57 patients with lateral epicondylitis in secondary care. Median age (range): i, 47 years (30–61), ii, 45 years (28–65); women: i, 18 (60%), ii, 15 (56%); median duration elbow complaints (range): i, 24 weeks (3–100), ii, 24 weeks (4–150). Inclusion criteria: history of pain on gripping or extensor stress test together with tenderness over the lateral epicondyle or adjacent tissues. Exclusion criteria: recent failed treatment, including corticosteroid injections.	i, 2 ml triamcinolone (20 mg) + lignocaine 1% ($n = 30$); ii, 2 ml triamcinolone (10 mg) + lignocaine 1% ($n = 27$) injection repeated after 4 weeks if necessary. No information on co-interventions. Adverse effects: i, 15 (50%); ii, 13 (48%) patients had post-injection pain; i, eight (27%), ii, five (18%) patients in whom skin atrophy was observed.	Baseline: (a) mean (95% CI) pain VAS: i, 63 (59, 67); ii, 66 (60, 71); (b) mean (95% CI) tenderness score (0-3): i, 2.3 (2.1, 2.6); ii, 2.2 (1.9, 2.6); (c) mean (95% CI) pain weighted grip strength: i, 103 (85, 120); ii, 133 (98, 168). Results after 4 weeks: (a) mean (95% CI) pain VAS: i, 28 (19, 37); ii, 27 (18, 37); (b) mean (95% CI) tenderness score (0–3): i, 0.8 (0.4, 1.1); ii, 0.6 (0.2, 0.9), (c) mean (95% CI) pain weighted grip strength: i, 200 (171, 230); ii, 228 (193, 263). Results after 8 weeks: (a) mean (95% CI) pain VAS: i, 22 (14, 31); ii, 29 (17, 40); (b) mean (95% CI) tenderness score (0–3): i, 0.7 (0.4, 1.1); ii, 0.6 (0.2, 0.9); (c) mean (95% CI) pain weighted grip strength: i, 196 (159, 232); ii, 211 (174, 247). Results after 24 weeks: (a) mean (95% CI) pain VAS: i, 33 (22, 45); ii, 35 (21, 48); (b) mean (95% CI) tenderness score (0–3): i, 0.8 (0.4, 1.2); ii, 0.8 (0.3, 1.3); (c) mean (95% CI) pain weighted grip strength: i, 193 (158, 228); ii, 217 (178, 256).	Conclusions of authors: more rapid relief of symptoms for 10 mg triamcinolone
Saartok and Eriksson (1986)	Randomisation procedure not described. Outcome assessor and care provider not blinded. No information on blinding patient. Outcome assessment at 2 weeks. No information on drop-outs.	21 patients with lateral epicondylitis in secondary care. Mean age: 45 year, women: 5 (24%). Inclusion criteria: typical history, typical signs and symptoms of epicondylitis of the humerus at the clinical examination, e.g. pain during extension of the wrist, impairment of mobility. Exclusion criteria: no treatment in previous 5 weeks.	i, 1.5 ml betamethasone (1 ml) + prilocaine (0.5 ml) injection + placebo naproxen tablets for 2 weeks ($n = 11$). ii, naproxen tablets (250 mg) twice a day for 2 weeks + 1.5 ml local saline injection ($n = 10$). Co-interventions: none. Adverse effects: pain at the injection site in a few cases (group unclear).	Baseline: (a) mean (sd) pain palpation (0–8): i, 5.4 (2.2); ii, 5.2 (1.6); (b) mean (sd) pain during isometric wrist extension (0–8): i, 0.9 (1.3); ii, 0.9 (2.1); (c) mean (sd) grip strength (mean of three squeezes of a Vigorimeter): i, 82.3 (33.6); ii, 66.3 (35.2). Results after 2 weeks: (a) mean (sd) pain palpation (0–8): i, 4.5 (2.1); ii, 4.2 (2.8); (b) mean (sd) pain during isometric wrist extension (0–8): i, 0.4 (0.5); ii, 1.1 (2.3); c) mean (sd) grip strength (mean of three squeezes of a Vigorimeter): i, 84.0 (29.0); ii, 75.0 (36.8); (d) overall evaluation by (6 point Likert scale): i, 3/11; ii, 4/10 patients cured or markedly improved; (e) overall evaluation by outcome assessor (4 point Likert scale): i, 5/11; ii, 5/10 patients asymptomatic or improved.	Conclusions of authors: no statistically significant difference between betamethasone injection and naproxen.

(*continued*)

Study characteristics

Study	Methods	Participants	Interventions	Outcome	Notes
Verhaar et al. (1996)	Randomisation using sealed numbered envelopes without strata or blocks. Patient, outcome assessor and care provider not blinded for intervention. Outcome assessment after 6 months and 1 year. Drop-outs: i, one, ii, two patients at 6 weeks.	106 patients with tennis elbow in secondary care. Mean (sd) age in years: i, 42.6 (9.9); ii, 43.0 (8.5); women: i, 22 (42%); ii, 25 (47%); concomitant neck complaints: i, 9 (17%); 15 (28%); concomitant shoulder pain: i, 8 (15%); ii, 15 (28%); mean duration of elbow complaints: 33 weeks (total group). Inclusion criteria: pain at the lateral side of the elbow, tenderness over the forearm extensor origin, pain at the lateral epicondyle during resisted dorsiflexion of the wrist with the elbow in full extension. Exclusion criteria: previous operation at the lateral side of the elbow, arthritis or allied conditions, neurological disorders of the painful extremity, more than three local corticosteroid injections within the last 6 months, same elbow treated before with Cyriax' methods.	i, Local corticosteroid injection; 1 ml of triamcinolone acetate suspension 1% + 1 ml lidocaine 1%; repeated at 2 or 4 weeks if necessary; one to three injections; 6 weeks ($n = 53$). ii, Physiotherapy by Cyriax: deep transverse friction and Mills' manipulation; thrice a week; 12 treatments; 4 weeks; followed by 2 weeks of restriction of all painful activities ($n = 53$). No information on co-interventions. Adverse effects: ii, one patient discontinued the treatment because of severe pain.	Baseline results: (a) Severity of pain (4 point scale): i, 0, ii, 0 patients pain absent; (b) occurrence of pain (4 point scale): i, 0, ii, 0 patients never pain; (c) Subjective loss of grip strength (4 point scale): i, 6 (11%); ii, 10 (19%) patients pain absent; (d) pain provoked by resisted dorsiflexion of the wrist (absent, slight, severe): i, 0, ii, 0 patients pain absent. Results after 6 weeks: (a) Severity of pain (4 point scale): i, 22/52, ii, 3/51 patients pain absent; (b) occurrence of pain (4 point scale): i, 22/52, ii, 3/51 patients never pain; (c) subjective loss of grip strength (4 point scale): i, 32/52; ii, 13/51 patients pain absent; (d) pain provoked by resisted dorsiflexion of the wrist (absent, slight, severe): i, 26/52; ii, 5/51 patients pain absent; (e) patient satisfaction (3 point scale): i, 35/52; ii, 14/51 patients satisfied; (f) mean increase (decrease) in grip strength affected limb(sd): i, 10.7 (14.9); ii, 2.3 (10.6); (g) mean increase (decrease) in grip strength unaffected limb(sd): i, −1.8 (5.6); ii, −0.6 (8.7). Results after 52 weeks: (a) Severity of pain (4 point scale): i, 9/52, ii, 16/51 patients pain absent; (b) occurrence of pain (4 point scale): i, 10/52, ii, 16/51 patients never pain; (c) subjective loss of grip strength (4 point scale): i, 26/52, ii, 25/51 patients pain absent, (d) pain provoked by resisted dorsiflexion of the wrist (absent, slight, severe): i, 16/52; ii, 23/51 patients pain absent; (e) patient satisfaction (3 point scale): i, 26/52; ii, 30/51 patients satisfied, (f) mean (sd) increase (decrease) in grip strength affected limb: i, 14.6(13.1); ii, 11.0(13.8); (g) mean (sd) increase (decrease) in grip strength unaffected limb: i, −0.3(6.8); ii, −0.1 (10.9).	Conclusion of authors: 'positive' in favour of corticosteroid injections at 6 weeks and 'negative' at 1 year follow-up.

References

Allander E. Prevalence, incidence and remission rates of some common rheumatic diseases and syndromes. Scand J Rheumatol 1974;3:145–153.

Assendelft WJJ, Hay EM, Adshead R, Bouter LM. Corticosteroid injections for lateral epicondylitis: a systematic overview. Br J Gen Pract 1996;46:209–216.

Bär C, Bias P, Rose P. Dexamethasonpalmitat bei akuter Epikondylitis humeri radialis. (Dexamethasonepalmitate for the treatment of tennis elbow.). Dtsch Zeitschr Sportmed 1997;48:119–124.

Baily RAJ, Brock BH. Hydrocortisone in tennis elbow. A controlled series. J R Soc Med 1957;50:389–390.

Brennan P, Silman A. Statistical methods for assessing observer variability in clinical measures. Br Med J 1992;304:1491–1494.

Chard MD, Hazleman BL. Tennis elbow: a reappraisal. Br J Rheumatol 1989;28:187–190.

Chop WM. Tennis elbow. Postgrad Med 1989;86:307–308.

Cohen J. A coefficient of agreement for nominal scales. Educ Psychol Meas 1960;20:37–46.

Cohen J. Statistical power analysis for the behavioral sciences, Hillsdale, NJ: Lawrence Erlbaum Associates, 1988.

Day BH, Govindasamy N, Patnaik R. Corticosteroid injections in the treatment of tennis elbow. Practitioner 1978;220:459–462.

Erturk H, Celiker R, Sivri A, Cetin A, Cindas A. The efficacy of different treatment regiments that are commonly used in tennis elbow. J Rheumatol Med Rehab 1997;8:298–301.

Freeland DE, Gribble MG. Hydrocortisone in tennis elbow. Lancet 1954;2:225.

Goldie I. Local steroid therapy in painful orthopedic conditions. Scott Med J 1972;17:176–186.

Gray RG, Gottlieb NL. Intra-articular corticosteroids. An update assessment. Clin Orthop 1983;177:235–263.

Gregoire G, Derderian F, le Lorier J. Selecting the language of the publications included in a meta-analysis: is there a tower of babel bias? J Clin Epidemiol 1995;48:158–163.

Haker E, Lundeberg T. Elbow-band, splintage and steroids in lateral epicondylalgia (tennis elbow). Pain Clinic 1993;6:103–112.

Halle J. Comparison of four treatment approaches for lateral epicondylitis of the elbow. J Orthop Sports Phys Ther 1986;8:62–69.

Hamilton PG. The prevalence of humeral epicondylitis: a survey in general practice. J R Coll Gen Pract 1986;36:464–465.

Hay EM, Paterson SM, Lewis M, Hosie M, Croft P. Pragmatic randomised controlled trial of local corticosteroid injection and naproxen for treatment of lateral epicondylitis of elbow in primary care. Br Med J 1999;319:964–968.

Hudak PL, Cole D, Haines T. Understanding prognosis to improve rehabilitation: the example of lateral elbow pain. Arch Phys Med Rehabil 1996;77:586–593.

Hunt DL, McKibbon KA. Locating and appraising systematic reviews. Ann Intern Med 1997;126:532–538.

Jadad AR, Moore A, Carroll D, Jenkinson C, Reynolds DJM, Gavaghan DJ, McQuay HJ. Assessing the quality of reports of randomized clinical trials: is blinding necessary? Control Clin Trials 1996;17:1–12.

Jüni P, Witschi A, Bloch R, Egger M. The hazards of scoring the quality of clinical trials for meta-analysis. J Am Med Assoc 1999;282:1054–1060.

Labelle H, Guibert R, Joncas J, Newman N, Fallaha M, Rivard C-H. Lack of scientific evidence for the treatment of lateral epicondylitis of the elbow: an attempted meta-analysis. J Bone Joint Surg 1992;74B:646–651.

Meade MO, Richardeson WS. Selecting and appraising studies for systematic review. Ann Intern Med 1997;127:531–537.

Miedema HS. Reumatology research (ROME): (Reuma-onderzoek meerdere echelons: basisrapport) report, Leiden: Nederlands Instituut voor Praeventieve Gezondheidszorg TNO, 1994.

Moher D, Fortin P, Jadad AR, Juni P, Klassen T, Le Lorier J, Liberati A, Linde K, Penna A. Completeness of reporting of trials published in languages other than English: implications for conduct and reporting of systematic reviews. Lancet 1996;347:363–366.

Moher D, Jones D, Cook DJ, Jadad AR, Moher M, Tugwell P, Klassen TP. Does quality of reports of randomised trials affect estimates of intervention efficacy reported in meta-analyses? Lancet 1998;352:609–613.

Mulrow CD, Oxman AD (eds). Cochrane Collaboration Handbook (updated September 1997). In: The Cochrane Library (database on disk and CDROM). The Cochrane Collaboration. Oxford: Update Software; 1997, Issue 4.

Murley AH, Lond MB. Tennis elbow: treated with hydrocortisone acetate. Lancet 1954;2:223–225.

Murtagh JE. Tennis elbow. Aust Fam Phys 1988;17:90–91 94–95.

Oksenberg D, Cuchacovich M, Alamo M, Goecke AS, Contreras LG, Catalán JG, Saavedra IS, Gaete LG, Gatica HR. Comparación de la eficacia clinica de una inyección intraarticular o intralesional de dos preparados de betametasona en pacientes con artrosis o epicondilitis. [Comparative effects of intra articular injections of two betametasone preparations in patients with osteoarthritis or epicondylitis]. Revista Medica De Chile 1998;126:623–628.

Price R, Sinclair H, Heinrich I, Gibson T. Local injection treatment of tennis elbow: hydrocortisone, triamcinolone and lignocaine compared. Br J Rheumatol 1991;30:39–44.

Saartok T, Eriksson E. Randomized trial of oral naproxen or local injection of betamethasone in lateral epicondylitis of the humerus. Orthopedics 1986;9:191–194.

Schulz KF, Chalmers I, Grimes DA, Altman DG. Assessing the quality of randomization from reports of controlled trials published in obstetrics and gynaecology journals. J Am Med Assoc 1994;272:125–128.

Schultz KF, Chalmers I, Hayes RJ, Altman DG. Empirical evidence of bias. Dimensions of methodological quality associated with estimates of treatment effects in controlled trials. J Am Med Assoc 1995;273:408–412.

Sutton AJ, Duval SJ, Tweedie RL, Abrams KR, Jones DR. Empirical assessment of effect of publication bias on meta-analysis. Br Med J 2000;320:1574–1577.

Van Tulder MW, Assendelft WJJ, Koes BW, Bouter LM. Method guidelines for systematic reviews in the Cochrane Collaboration Back Review Group for Spinal Disorders. Spine 1997;22:2323–2330.

Van Tulder MW, Cherkin DC, Berman B, Lao L, Koes BW. The effectiveness of acupuncture in the management of acute and chronic low back pain. A systematic review within the framework of the Cochrane Collaboration Back Review Group. Spine 1999;24:1113–1123.

Van der Windt DA, van der Heijden GJMG, van den Berg SGM, ter Riet G, de Winter AF, Bouter LM. Ultrasound therapy for musculoskeletal disorders: a systematic review. Pain 1999;81:257–271.

Verhaar JAN. Tennis elbow [thesis], . Maastricht: University Press, 1992.

Verhaar JA, Walenkamp GH, van Mameren H, Kester AD, van der Linden AJ. Local corticosteroid injection versus Cyriax-type physiotherapy for tennis elbow. J Bone Joint Surg [Br] 1996;78:128–132.

Yates DA. Use of local steroid injections. Br Med J 1977;19:495–496.